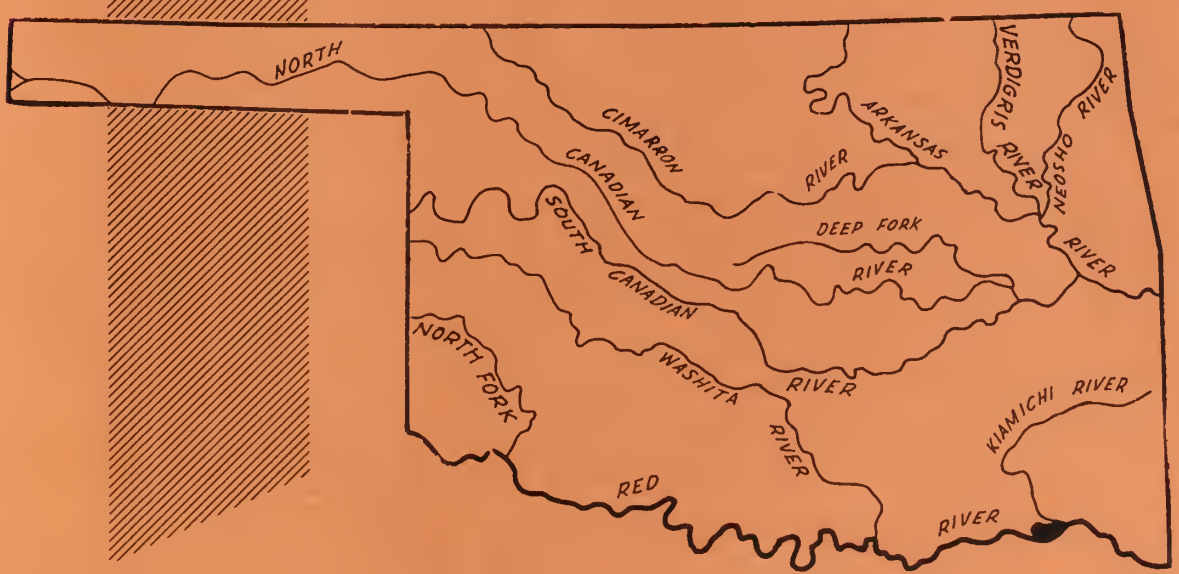
WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

FROGVILLE CREEK WATERSHED

Choctaw County, Oklahoma



PREPARED UNDER THE AUTHORITY OF THE WATERSHED PROTECTION AND FLOOD PREVENTION ACT
(PUBLIC LAW 566, 83RD CONGRESS; 68 STAT. 666) AS AMENDED

Prepared by: Kiamichi Soil and Water Conservation District

Frogville Conservancy District No. 1

With Assistance By
U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
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FROGVILLE CREEK WATERSHED
Choctaw County, Oklahoma
February 1965

SUMMARY OF PLAN

General Summary

The work plan for watershed protection, flood prevention, and agricultural water management was prepared by the Kiamichi Soil and Water Conservation District and the Frogville Conservancy District as sponsoring local organizations. The United States Department of Agriculture, Soil Conservation Service provided technical assistance in preparing the plan.

The watershed is located in the southeast part of Choctaw County, Oklahoma, and comprises approximately 6,584 acres of Red River Terrace alluvium and 2,587 acres of upland.

The present land use of the watershed is: cropland, 31.5 percent; pasture, 64.0 percent; wildlife area, 1.5 percent and miscellaneous, 3.0 percent.

There are no Indian lands under the supervision of the Bureau of Indian Affairs in the watershed.

Frequent flooding and inadequate drainage prevent efficient utilization of bottomlands for agricultural production and cause damages to growing crops and pastures.

The principal project objective is to reduce agricultural production losses.

The project will serve approximately 26 owners of bottomland. This land is at present being used for agricultural production.

The estimated time required for the installation of the project is 5 years. The total project installation cost is estimated to be $709,394. Of this total $346,895 will be borne by Public Law 566 funds and $362,499 will be borne by other funds.

Land Treatment Measures

Landowners and operators will install land treatment measures which have a measurable effect on the reduction of floodwater, sediment, and erosion damages and problems associated with agricultural water management.

The estimated total cost of land treatment measures to be established is

$227,392. This includes Public Law 566 funds of $5,000 for accelerated technical assistance during the 5-year installation period and $222,392 from other sources.

Structural Measures

The plan provides for the construction of 2 floodwater retarding structures and 11.94 miles of mains and laterals with appurtenant structures. The total estimated cost of structural measures is $482,002 of which Public Law 566 share is $341,895 and the share from other sources is $140,107.

Damage and Benefits

Benefits accruing to the project are in the form of flood prevention and in the increased net value of crop and pasture production.

Structures for flood prevention and agricultural water management will produce average annual primary benefits of $80,210 distributed as follows:

Flood prevention and more intensive land use	$70,854
Agricultural Water Management (Drainage)	9,356
	$80,210

The ratio of average annual primary benefits $80,210, to the average annual cost of structural measures $27,610 is 2.9 to 1 (table 5).

Local secondary benefits stemming from and induced by the project amount to $10,813.

Rural Redevelopment benefits accruing from the use of local unemployed or underemployed labor in installing structural measures and for operation and maintenance were estimated at $2,303.

The total average annual benefits accruing from the project were estimated at $93,326.

The conservation benefits from land treatment measures were not evaluated or used in project justification. Experience has shown that such soil and water conservation measures produce benefits in excess of their costs.

Provisions for Financing

The officers of sponsoring organizations expect most land easements and rights-of-way to be donated. When sponsors find that needed resources by donation have been exhausted, they will estimate the amount of funds

needed to complete the project. This estimate will include the sponsor's share of the construction cost of the channel improvement. Needed funds will be obtained from local financing or from the Farmers Home Administration. The conservancy district will repay borrowed funds from assessments on benefited land.

Operation and Maintenance

Land treatment measures for watershed protection will be maintained by the landowners and operators of farms on which the measures are installed under agreements with the Kiamichi Soil and Water Conservation District.

The floodwater retarding structures, mains and laterals with their appurtenant structures will be operated and maintained jointly by the Kiamichi Soil and Water Conservation District and the Frogville Conservancy District. The estimated average annual cost for operation and maintenance is $11,816 (includes allowance of $9,454 annually for replacement of facilities).

DESCRIPTION OF THE WATERSHED

Physical Data

The Frogville Creek Watershed is located in the southeast part of Choctaw County, Oklahoma and comprises approximately 2,587 acres of upland and 6,584 acres of Red River Terrace alluvium.

There are no incorporated towns in the watershed.

The bottomland portion of the watershed is in the Bottomland land resource area, and the upland is in the Forested Coastal Plain land resource area. The surface geology of the watershed consists of Pleistocene terraces in the upland area and Recent alluvium in the bottomland.

The upland soils have been developed under forest cover and are only moderately productive. The surface soils are mostly medium textured and the subsoils range from permeable to slowly permeable.

The bottomland soils are fine to medium textured, permeable to slowly permeable and very fertile. The topography of the upland portion of the watershed is gently rolling to hilly while the bottomland portion is almost level. Elevations range from 480 feet mean sea level in the north to 370 feet in the south part of the watershed.

The average date of the last killing frost in the spring is March 23 and that of the first killing frost in the fall is November 8 providing a normal frost free period of 231 days. The average annual precipitation is 47.08 inches.

Present land use in the watershed is as follows:

Land Use	Acres	Percent
Cropland	2,895	31.5
Pasture	5,867	64.0
Wildlife Area	134	1.5
Miscellaneous 1/	275	3.0

1/ Includes roads and farmsteads.

Water for livestock and domestic use is supplied by farm ponds and wells. Well water is obtained from sands at depths ranging 20 to 100 feet.

There are four channels in the watershed and each one with its individual drainage area is considered a separate hydrologic unit.

Channels No. 1 and 4 head in the upland portion of the watershed and flow across the Red River terrace. Channel No. 1 empties into the Kiamichi River about two miles above its confluence with Red River while Channel No. 4 empties into Red River. Channel No. 3 and 5 originate on the river terrace and flow into Red River.

Economic Data

The farm and ranch units in this watershed are mostly owner-operated and are above average in size for the area. They range in size from 40 to 2,067 acres, with relatively few small units.

There are approximately 40 farm and ranch units in the watershed. Most of the bottomlands are owned by large operators. The trend is toward larger farm units. Bottomland recently sold has been bringing $300 per acre and upward. Upland farms adjacent to the bottom command a good price, going at $150 to $200 per acre.

The bottomland soils of the watershed are fertile. Where flooding and drainage problems do not interfere the soils are capable of producing a wide variety of crops. Alfalfa is the principal crop grown. Five cuttings are usually harvested. The first crop in the spring and the last crop in the fall are generally sold to the alfalfa dehydrating mill located just outside the west boundary of the watershed. There is a good market for hay. Cotton is the second most important crop grown. Yields of 1½ to 2 bales per acre are common. Most of the sandy Red River alluvium soils lying above flood levels are planted to cotton. Yields of corn and grain sorghum are good but most farmers other than cotton growers are not equipped for growing row crops. Hay is produced principally from alfalfa. Some sudan and sorghum hybrids are grown for hay on wet lands. Most permanent pastures are either bermuda grass based (on sandy soils) or fescue-ladino mixtures (grown on heavier soils). Beef cattle are an important source of income to many farmers in the watershed. There are no dairy enterprizes in the watershed.

There are no industrial enterprizes in the watershed. An alfalfa dehydrating mill, located at the intersection of Highway No. 109 and U. S. Highway No. 271 just south of Hugo, gets a lot of the alfalfa it uses from the watershed. Most farmers sell their first crop of alfalfa in the spring and the last crop in the fall to the dehydrating plant. The dehydrating plant harvests these two cuttings of alfalfa. The owner of the dehydrating plant owns a sizeable farm in this watershed. All of his alfalfa is taken to the dehydrating plant. Since the inception of this study, a large food processing plant has been built at nearby Paris, Texas (25 miles). The building of this plant will make it possible for farmers in this watershed to grow high cash value truck crops.

The watershed is adequately served by 12 miles of roads. State Highway No. 109 practically bisects the watershed. Except when flooded where it crosses Frogville Creek it affords easy access to the north and east and to the west and south. A new bridge on this highway, over the Kiamichi River is under construction at this time. Plans for black-topping this highway are pretty well advanced.

School children of the watershed attend school in Fort Towson, Oklahoma,

which is the nearest town to the watershed. One country store is located near the center of the watershed. Hugo, Oklahoma to the west and Paris, Texas to the south, are the main trade centers for the residents of the area.

The watershed is located in Choctaw County, a county that has been designated by the Area Redevelopment Administration as a depressed area suffering from chronic unemployment.

Land Treatment Data

The watershed is served by the Soil Conservation Service Work Unit at Hugo, which assists the Kiamichi Soil and Water Conservation District. Work Unit personnel have helped farmers in the watershed plan and install conservation measures on agricultural land. There are 35 Soil and Water Conservation District Cooperators in the watershed, of which 33 have developed basic plans. Approximately 80 percent of the watershed is covered by soil and water conservation agreements. Approximately 65 percent of the planned practices have been applied and approximately 30 percent have complete treatment (table 1A).

The trend in the watershed has been toward the development of tame pastures and increased acreages of alfalfa. Very little of the upland is used for clean tilled crops under present conditions. Land use and conservation practices have reduced erosion to the extent that it is not a serious problem and sediment production rates are very low.

WATERSHED PROBLEMS

Floodwater Damage

The Frogville Creek Watershed comprises a total of 9,171 acres of land. There are 2,587 acres of upland and 30 acres of stream channels. The remaining area, 6,584 acres of Red River alluvium, includes 1,377 acres of flood plain, 1,003 acres of inherently wet land outside the flood plain which needs drainage, 1,270 acres of land, not inherently wet, that is damaged by prolonged periods of inundation due to inadequate outlets for runoff and 2,904 acres of Red River alluvium not subject to flooding.

The flood plain, as described in this plan, is that area inundated by the runoff from a 25-year frequency storm. Such a storm as this occurred in September 1954. Drainage is needed on 2,380 acres of which 1,377 is flood plain and 1,003 acres is inherently wet land that does not flood. Another 1,270 acres, not inherently wet is damaged by prolonged inundation because of inadequate outlets.

The problem area (benefitted area) includes 3,650 acres of land.

The 20-year evaluation period, 1942 through 1961, was selected to represent normal rainfall and flood conditions. During this period there were 51 major floods and 59 minor floods. A major flood is one that inundated more than 50 percent of the flood plain. Twenty-one of the major floods and 20 of the minor floods occurred during the spring growing season. Thirteen of the major storms, including five of the seven largest storms, occurred in the fall months. These storms caused heavy damage to growing crops.

A recent major flood occurred in September 1957. The damage from this storm was aggravated because of floods on the Red River. During this flood period close to a maximum discharge was being released from Denison Dam, a Corps of Engineers project some 90 miles upstream from the watershed. Farmers in the Frogville Creek Watershed contacted in the course of this study reported considerable fence damage and some losses of livestock during the floods of 1957. Generally the flooding in the Frogville Creek Watershed is less than 3 feet in depth and does not cause severe loss to fences or drown livestock. However, in 1957 floods on the Red River were so high that floodwater in the Frogville Creek Watershed could not drain away, hence the fence damage and loss of livestock. Since the damages occasioned by this event are not subject to improvement by this project these damages were not evaluated for benefit cost analysis. With this elimination, benefits from damages to other agricultural property were considered minor in relation to other items evaluated.

The bottomland areas of the watershed flood frequently. Flooding is intensified on the main channel of Frogville Creek by the runoff from upland in the west end of the drainage area. This is also true of the channel that drains the upland area west of the Frogville Community store. All of the channels that drain this watershed are inadequate to carry storm runoff.

The bottomland soils are fertile and relatively level. Each year as rains occur the floodwaters spread over much of the project area causing damage to growing crops. Due to poor surface drainage, the water stands on parts of the watershed for several days - until it evaporates or is removed by influent seepage.

Even minor floods cause considerable damage as they delay the seeding, cultivation and harvesting of crops on many areas not inherently wet.

Much of the land in the flood plain of the various channels is in brushy pasture. Some areas once cleared and broken out for crops and pasture have reverted to brush because of the flood risk.

To locate and designate the various problem areas, the watershed was divided into four evaluation reaches: Figure 4.

Erosion Damage

Most of the upland of the watershed is used for pasture and erosion rates are relatively low. Upland sheet erosion causes 95 percent of the sediment production in the watershed. The remaining sediment is from roads, 2 percent; miscellaneous area, 1 percent and small gullies, 2 percent. There are no critical sediment source areas in the watershed. The gross erosion rate in the watershed under present conditions is approximately 2.6 tons per acre per year. Damages from sheet and channel scour on the flood plain are very low and were not evaluated. Low stream gradients and shallow flooding account for this condition.

Sediment Damage

Borings were made along 40 percent of the hydrologic cross-sections. From these borings it was found that sediment damages to the flood plain are negligible. All channels were inspected along 40 percent of the cross-sections and only small amounts of aggradation have occurred in the upper ends of channels 1 and 4. Increased flooding as a result of channel filling is negligible. No sediment damages to any other facilities have occurred. Productivity has not been affected and there are no swamping damages from sediment deposits.

Problems Relating to Water Management

Approximately 20 percent or 1,377 acres of the bottomland area is Frogville Creek flood plain which is subject to frequent flooding. This area also needs group and on-farm drainage systems to accelerate the removal of surface waters to prevent agricultural damage. An additional area of 1,003 acres, not subject to flooding by Frogville Creek, is inherently wet. This area needs group laterals and on-farm drainage.

Of the total bottomland area (6,534 acres), 3,650 acres need either protection from flooding or drainage systems, or both.

There is no supplemental irrigation in the watershed. Rainfall is usually sufficient for production of most crops suited to the area.

PROJECTS OF OTHER AGENCIES

Flooding of the watershed by overbank flow of the Red River has been reduced since the completion of the Denison Dam project, under the supervision of the U. S. Army, Corps of Engineers.

State Highway 109 which traverses the watershed is planned by the State Highway Department for realignment and hard surfacing. The State Highway Department has made provision in its plans to include adequate structures at intersections of the highway for mains and laterals which

are proposed in this work plan.

BASIS FOR PROJECT FORMULATION

A reduction of floodwater damage and the alleviation of inadequate drainage on a large body of highly productive land provides the basis for the development of this watershed work plan.

The project area includes 9,171 acres. There are 2,587 acres of upland and 30 acres of stream channels. The flood plain, comprizing 1,377 acres, needs both flood protection and drainage. In addition there is 1,003 acres of wet land outside the flood plain that needs drainage; 1,270 acres of land, not inherently wet, which is damaged by prolonged periods of inundation due to lack of outlets for storm runoff; and 2,904 acres of Red River alluvium not subject to flooding. The areas of Red River alluvium are not contiguous masses but are interspersed throughout the project area. The channels that drain this watershed are inadequate to carry storm runoff.

The land is very productive and cropped mainly to cotton and alfalfa. Both crops have a fairly low level of tolerance to duration of flooding. Therefore, the sponsors felt that a high level of protection was needed. Because of the inseparable nature of the problems, a system of floodwater retarding structures, channel improvement and drainage was required to permit proper utilization of the project area.

A large food processing plant is being built near the south boundary of the watershed. This likely will result in a reorganization of the cropping program on many farms. Most fresh vegetable crops have a very low tolerance to floodwater.

Therefore, to solve the floodwater and agricultural water management problems of the watershed, the local organization and Soil Conservation Service agreed to the following objectives:

1. Accelerate application of essential land treatment measures.

2. Protect 1,377 acres of flood plain from a 5-year, 12-hour storm.

3. Remove the runoff from the other agricultural land within 18 hours, and reduce flood damages by 85 to 90 percent.

4. Provide group outlets for areas in the watershed needing drainage.

5. Provide the maximum feasible protection for fish and wildlife resources.

The measures included in the work plan meet the objectives of the sponsors and provide for development of the watershed in keeping with its needs.

No irrigation is practiced in the watershed at this time. However, the construction of the large food processing plant nearby will probably make irrigation profitable for those farmers who wish to grow vegetables. Ample water to irrigate the whole project area is readily accessible from the Kiamichi and Red Rivers. Water rights are no problem as most of the water resources of both streams are unassigned.

The sediment pools of the two floodwater retarding structures will materially improve the fish and wildlife resources of the area by providing a permanent water supply for wild creatures. They will also afford considerable incidental recreation benefits to the residents and visitors to the area.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs, such as now being carried out by the Kiamichi Soil and Water Conservation District, is necessary for a sound flood prevention and agricultural water management program on the watershed. The extent of needed land treatment measures which have been applied to date within the watershed represents an expenditure by landowners and operators of approximately $138,498 (table 1A).

A combination of land treatment measures is basic and essential for the provisions of watershed protection, flood prevention, and agricultural water management. Table 1 includes estimates of the acres of cropland and grassland on which a combination of land treatment measures are to be applied during the 5-year installation period. Also included in Table 1 is the estimated costs of applying the land treatment measures. The measures will be established and maintained by landowners and operators in cooperation with the going district program.

In addition to the presently available technical assistance, $5,000 will be made available from Public Law 566 funds to accelerate the establishment of these measures.

Land treatment measures that are associated with good land management will include the use of conservation cropping systems, contour farming, cover and green manure crops, crop residue use, weed control, proper use, and pasture planting.

Land treatment measures associated with agricultural water management development will include the installation of field drainage ditches.

Land grading, land smoothing, and row arrangement will condition the land so that excess water can be removed before extensive crop damage occurs.

The agricultural trend in land use is to bermuda grass and increased acreages of alfalfa.

Structural Measures

Two floodwater retarding structures, 11.94 miles of mains and laterals with appurtenances constitute the planned structural measures.

The floodwater retarding structures will provide flood protection for the flood plains of mains number 1 and 4. The total floodwater detention capacity of the two structures is 5.26 inches (609 acre-feet). The 100-year sediment pools will cover 12 acres of bottomland and 12 acres of upland. The floodwater detention pools when completely filled, will cover an additional 17 acres of bottomland and 66 acres of upland. The controlled area is 2.17 square miles or 15.14 percent of the total drainage area.

The mains and laterals will provide floodwater protection and the required drainage for efficient crop production. The channel capacities are based on a 5-year, 12-hour storm. Additional capacity is provided in mains number 1 and 4 to carry the release flow from the floodwater retarding structures.

Main ditch number 3 enters into the upper end of an old scour channel which opens into the main channel of Red River. This scour channel is apparently stable.

Spoil will be shaped or spread adjacent to the ditch. In areas where land is already cleared and is in cultivation or improved pastures, the spoil will be spread to a maximum height of 3 feet and 8 to 1 outside side slope. Where the area to be occupied by the spoil is still in timer, which must be cleared, the spoil will be shaped to a maximum height of 5 feet and 4 to 1 outside slope (figure 1A). Spoil will be placed on one or both sides, depending on its quantity. When possible spoil will be placed on one side only in order to save right-of-way and clearing cost. No spoil will be moved beyond the boundaries of the right-of-way designated on the land rights map (figure 3).

The boundaries of the rights-of-way needed for excavation and spoil spreading will be shown on the land rights map. The location of the channel on the project map is approximate, but it will be constructed within right-of-way as shown on the land rights map.

No fences will be built within design depth of any channel. Where fences cross channels, suitable water gates will be installed and costs

will be borne by local interest.

The mains and laterals are designed to serve two or more landowners. The bringing of new land into agricultural production is not a primary purpose of this project.

Loss of upland game habitat directly or indirectly due to construction of structural measures will be compensated by planting suitable shrubby type vegetation along the ditch banks and berms to provide food and cover for wildlife. Also, owners of the floodwater retarding structures will be encouraged to develop wildlife habitat within the fenced area of the structure. The Oklahoma Department of Wildlife Conservation will assist in providing technical assistance in the vegetative plan.

The estimated installation cost of the two floodwater retarding structures is $110,822 (table 2). The estimated installation cost of mains, laterals and appurtenant structures is $371,180 (table 2).

EXPLANATION OF INSTALLATION COSTS

Public Law 566 funds to provide technical assistance during the 5-year installation period to accelerate the installation of land treatment measures for watershed protection, amounts to $5,000. Local interests will install the land treatment measures at an estimated cost of $222,392, which includes any assistance under going programs.

The estimated installation cost of the 2 floodwater retarding structures allocated to Public Law 566 funds is $93,492. This cost includes $14,003 for engineering services and $5,789 for other installation services (table 2). Construction cost estimates and contingency allowances are based on cost records of structures in similar areas of Oklahoma. The installation cost of the floodwater retarding structures to be paid for from other funds is $17,330. This cost includes land easement values, $15,130; legal fees, $400; relocation of roads and bridges, $1,000; and administration of contracts, $800.

The estimated installation cost of mains and laterals and appurtenant structures to be paid by Public Law 566 funds is $248,403, which includes $190,156 for construction, $41,220 for engineering services, and $17,027 for other installation services. The installation cost of the drainage system to be paid from other funds is $122,777, which includes construc tion cost $26,794, easement and rights-of-way with associated costs $93,733, and administration of contracts $2,250. Easement and rights-of-way cost includes land values of $81,758; legal fees $475, relocation of roads and bridges $11,500.

The total cost for all structural measures is $482,002. The total project cost is $709,394.

The estimated schedule for obligations for the 5-year installation period for both land treatment and structural measures is:

Fiscal Year	Public Law 566 Funds	Other Funds	Total
1st	20,000	61,695	81,695
2nd	171,947	95,402	267,349
3rd	151,948	85,402	237,350
4th	1,500	80,000	81,500
5th	1,500	40,000	41,500
Total	346,895	362,499	709,394

The first alternate method outlined in paragraph 1132.211 of the National Watershed Protection Handbook was used in allocating project cost. On the basis of this method the percent allocation of costs between flood prevention and agricultural water management are respectively: channel number 1, 74.13 and 25.87; channel number 3, 82.19 and 17.81; channel number 4, 78.97 and 21.03; and channel 5, 76.30 and 23.70. The total installation cost of structural measures $482,002 is allocated $391,485 to flood prevention and $90,517 to agricultural water management.

EFFECTS OF WORKS OF IMPROVEMENT

After the installation of the combined program of land treatment and structural measures, average annual flooding will be reduced from 3,025 acres to 104 acres, a reduction of 97 percent. Average annual flooding greater than three feet deep will be reduced from 14 to 2 acres.

It is expected that all of the 51 major floods such as those which occurred during the 20-years evaluation period, 1942 - 1961, would be reduced to minor floods. A major flood is one that inundates over one half of the flood plain. Twenty eight of the 59 minor floods would be eliminated after the installation of the project. Only three of the floods in the evaluation series could be expected to flood more than 10 percent of the flood plain after project installation.

It is expected that, after project installation, inundation of the flood plain from the largest storm in the series, a 25-year frequency event, will be reduced from 1,377 acres to 344 acres, a reduction of 75 percent. The peak discharge for this storm at reference valley section 1-13 (figure 4) is 905 C.F.S. After land treatment the discharge will be reduced to 887 C.F.S. With the installation of the structural measures the peak discharge is actually increased to 1,220 C.F.S., but the depth is reduced by 2.4 feet. Figure 2 graphically illustrates this.

The following table illustrates the acres flooded below planned structures by runoff from storms of specified frequencies without the project and with the project installed.

Areas Inundated Below Site Locations

Evaluation Reach Number 1/	Average Recurrence Interval: 1-Year Without Project	1-Year With Project	5-Year Without Project	5-Year With Project	10-Year Without Project	10-Year With Project	25-Year Without Project	25-Year With Project
1	400	2	486	11	517	21	549	65
3	100	0	147	10	158	19	170	34
4	159	3	288	43	314	72	342	109
5	158	9	277	40	297	78	316	136

1/ See Figure 4.

The improved channels were designed to carry the peak discharge for the 5-year, 12-hour storm to alleviate floodwater damage on the flood plain. This channel will also provide adequate outlets for the 1,003 acres of inherently wet land needing drainage and 1,270 acres of land not having adequate outlets. This will allow these lands to be drained in less than 18-hours, providing protection to growing crops as well as allowing crops to be planted and harvested at the most opportune time. It was observed that the largest floods occur in the fall when cotton and alfalfa are being harvested. This channel will also provide ample protection in anticipation of the future production of vegetable crops.

The existing slough at the lower end of channel 5 will be left for fish and wildlife use. The outlet end of the slough will be left as is, and the size and depth will not be effected. The slough is several feet deeper than its outlet or the channel. At present the small flows are blocked from entering this slough and they evaporate. With the installation of channel 5 these small flows will replenish and keep a fresh water supply in the slough, which will greatly benefit fish and wildlife.

The floodwater retarding structures and surrounding areas will partially offset any losses that might occur as a result of clearing and draining of the shallow swampy areas.

The ditch banks and berms of the improved channels will have vegetation and plantings to provide food and cover for wildlife. (See figure 1-A)

The owners of Site 2 indicated they planned to open it to the public for fishing and swimming.

PROJECT BENEFITS

The average annual benefits resulting from the installation of the project for flood prevention and water management, as outlined in this work plan, are estimated to be $80,210. The primary agricultural benefits from flood prevention are estimated to be $70,854 and the benefits from drainage $9,356.

Flood damages to the 1,377 acres of flood plain and 1,270 acres of land (not inherently wet) without adequate outlets were estimated to amount to $41,729 without project. It was estimated that these damages would be reduced to $686 by installation of the land treatment and structural measures. Therefore, the reduction amounts to 98.4 percent.

It is estimated that it will take ten years for the full benefits of the project to be realized. A five year installation period is allowed in the work plan for the installation of the two floodwater retarding structures, four main drainage channels and group laterals. An additional five years likely will be needed for on farm drainage measures to be installed and become fully effective. Therefore, all benefits were discounted for a 10-year lag in accrual. On some parts of this watershed benefits from reduction in floodwater damages and from drainage will accrue to the same land. The benefits to this land have been allocated to flood prevention and agricultural water management in proportion to the costs of each measure. Other lands in this watershed, not inherently wet, suffer damage from prolonged inundation from off-site water that cannot drain off for lack of adequate outlets. Floodwater damage on these areas is estimated to amount to $25,311.

Gross sales of agricultural crops will be increased from $63 per acre under present conditions to approximately $93 per acre when the project is completed and benefits from water management are fully realized.

The installation of the project for flood prevention and drainage will provide benefits from reduced road and bridge damage, reduced costs for transportation and movement of farm products, halting of mail and school bus service and other direct and indirect damage reductions that have not been evaluated for benefit-cost analysis. Benefits from these sources are minor in their relationship to those sources evaluated.

Secondary benefits, accruing as a result of the project amount to $10,813 annually. From a national standpoint secondary benefits are not considered significant. Locally the effects of the project will be important to the economy of the whole trade area. An alfalfa dehydrating plant located just outside the west boundary of the watershed harvests a large portion of its alfalfa supplies off lands of the watershed. Most farmers sell their first crop of alfalfa in the spring and the last crop in the fall to the dehydrating plant. These two crops are harvested by the alfalfa plant. Without this explanation the variable costs shown for alfalfa in Table A may seem low. Harvesting by the processors provides an opportunity for off the farm employment in an area of chronic unemployment.

Because of suitable land and resultant high yields, cotton is and will remain an important crop in the area. The location and building of a large food processing plant at nearby Paris, Texas (25 miles) will cause several farmers in this watershed to shift some of their land to the production of high value truck crops. A large increase in the acreage of alfalfa grown will follow the installation of the project.

These changes in the cropping system will increase employment and help processors and other business establishments in the area.

This watershed is located in Choctaw County which has been designated by the Area Redevelopment administration as a depressed area. Redevelopment benefits amounting to $2,303 from alleviation of unemployment will result from the project.

Construction of the two floodwater retarding structures included in this project will materially increase the recreational opportunities of the area. The owner of Site No. 2 indicated he plans to open it to the public for fishing and swimming. Since his plans did not include the development of any recreational facilities no attempt was made to evaluate and claim any recreational benefits. However, the sediment pools of the two floodwater retarding structures will provide considerable incidential recreational benefits for the community.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of structural measures, (amortized total installation cost plus operation and maintenance cost) is estimated to be $27,610. After project installation, structural measures are expected to produce average annual primary benefits of $80,210. Therefore, the structural measures will produce benefits of $2.91 for each dollar of cost.

With secondary and redevelopment benefits added, the total average annual benefits accruing to the project will amount to $93,326.

The benefit cost ratio for the project, as shown in Table 6, is 3.4 to 1.

PROJECT INSTALLATION

The sponsoring organizations and other interested agencies will carry out the educational phase of the program. This will be accomplished by conducting general information and local community meetings, preparing radio and press releases, and using other methods of getting information to the landowners, operators, and other interested groups in the watershed. This will help achieve understanding and stimulate participation in the entire plan, including the land treatment practices and the structural measures for flood prevention and agricultural water management.

The amounts of land treatment measures in Table 1 are those which will be established by the landowners and operators in cooperation with the Kiamichi Soil and Water Conservation District during the 5-year installation period.

The Soil Conservation Service through the Kiamichi Soil and Water

Conservation District is giving technical assistance in the planning and application of land treatment measures under their going programs. Technical assistance will be accelerated by assignment of additional personnel, as needed, to assure satisfactory planning progress and the application of the planned measures within the project installation period.

The governing body of the soil and water conservation district, with the assistance of other sponsoring organizations, will arrange for meetings according to a definite schedule. By this means and by individual contacts, they will encourage landowners and operators to adopt and carry out soil and water conservation plans. District owned equipment will be made available in accordance with present working arrangements.

The Kiamichi Soil and Water Conservation District will contract or arrange for contracting the floodwater retarding structures and channel improvement.

Land easements, rights-of-way, roads, utilities, pipelines, and removals or relocations for the construction of the reservoirs and channel improvement will be provided by the soil and water conservation district and other local sponsoring organizations at no cost to the Federal Government.

Technical assistance will be provided by the Soil Conservation Service to assist in the preparation of plans and specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of the planned structural measures for flood prevention and sediment reduction.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement as described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended.

Construction of planned structural measures will be started after the project is approved, the contracting agencies have funds available and are prepared to discharge their responsibilities, Public Law 566 funds have been appropriated, the necessary easements have been obtained, and operation and maintenance agreements have been executed.

The sponsoring organizations understand their obligations. The Kiamichi Soil and Water Conservation District is a legal subdividion of the State of Oklahoma, and has powers of eminent domain and the authority to use State revolving funds in watershed operations. The Kiamichi Soil and Water Conservation District will provide for financing the local sponsoring organization's responsibilities in construction by contribution

of easements, services and monies, and through the use of State, county, and watershed revolving funds.

The non-Federal part of installing the project will be met largely by donations of land easements or rights-of-way, material, labor, equipment, services and money. All landowners were contacted by the local sponsors during the development of the work plan, and it is expected that the major portion of the land easements and rights-of-way will be donated. Donations will be supplemented by private credit where feasible.

If funds obtained by contribution or use of local, county and State revolving funds prove inadequate, the amount of additional funds needed to finish the project will be estimated. Needed funds will be obtained from local financing or from the Farmers Home Administration. If a loan is obtained from the Farmers Home Administration, the Frogville Conservancy District will use its power of assessment to assure repayment of the loan.

The cost of the land treatment measures will be borne by the individual farmers and ranchers upon whose land these measures will be installed. The County Agricultural Stabilization and Conservation Committee will cooperate by selecting and providing financial assistance for those land treatment measures which will meet the conservation objectives in the shortest possible time.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

The land treatment measures on privately-owned lands will be operated and maintained by the landowners or operators of the farms on which the measures are installed under agreement with the Kiamichi Soil and Water Conservation District. Representatives of the district will make or cause to be made periodic inspections of the completed land treatment measures to determine maintenance needs and to encourage landowners and operators to perform needed maintenance. The soil and water conservation district will make district owned equipment available for this purpose.

Structural Measures

The floodwater retarding structures, mains, laterals and the appurtenant structures will be operated and maintained jointly by the Kiamichi Soil and Water Conservation District and the Frogville Conservancy District. The mains, laterals and appurtenant structures will be inspected at least annually and after each heavy rain or streamflow to determine the need for maintenance, such as control of vegetation, the removal of debris, sediment, or other obstacles which could result in the reduction of channel capacity or the control of excessive erosion. Floodwater retarding structures will be inspected in the same manner to determine

the need for maintenance. Items of inspection will include, but not be limited to, the conditions of the principal spillway, the emergency spillway, the embankment, vegetative cover and fences and gates installed as a part of the structure.

The sponsoring local organizations will maintain a record of all maintenance inspections and maintenance performed and make this information available to Soil Conservation Service personnel.

The Soil Conservation Service, through the Kiamichi Soil and Water Conservation District, will participate in the operation and maintenance only to the extent of furnishing technical assistance, to aid in inspections and furnishing technical guidance and information necessary for the operation and maintenance program.

The estimated average operation and maintenance cost is $11,816 (includes allowance of $9,454 annually for replacement of facilities), based on long term price levels. Maintenance work will be accomplished through the use of contributed labor and equipment, by contract, district owned equipment, force account, or a combination of these methods. Funds for maintenance work will be obtained by donation or from revenue derived from levies on the benefited lands in the watershed.

District and Federal representatives will have free access to inspect the improvements at any time.

The sponsoring local organizations fully understand their obligations for maintenance and will execute maintenance agreements prior to an invitation to bid.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Frogville Creek Watershed, Oklahoma

Item	Unit	Number 1/ to be Applied	Estimated Cost (Dollars) 2/ Public Law 566 Funds	Other	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	3,250		77,122	77,122
Grassland	Acre	5,153		144,600	144,600
Wildlife Habitat Development	Acre	134		670	670
Technical Assistance			5,000		5,000
SCS Subtotal			5,000	222,392	227,392
TOTAL LAND TREATMENT			5,000	222,392	227,392
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Str.	No.	2	73,700	-	73,700
Main Channels, Laterals & Appurtenant Structures	Feet (Mile)	63,050 (11.94)	190,156	26,794	216,950
SCS Subtotal			263,856	26,794	290,650
Subtotal Construction			263,856	26,794	290,650
Installation Service					
Soil Conservation Service					
Engineering Services			55,223		55,223
Other			22,816		22,816
SCS Subtotal			78,039		78,039
Subtotal - Installation Services			78,039		78,039
Other Costs					
Land Easements and Rights-of-Way				110,263	110,263
Administration of Contracts				3,050	3,050
Subtotal - Other Costs				113,313	113,313
TOTAL STRUCTURAL MEASURES			341,895	140,107	482,002
TOTAL PROJECT			346,895	362,499	709,394
SUMMARY					
Subtotal SCS			346,895	362,499	709,394
TOTAL PROJECT			346,895	362,499	709,394

1/ No Federal Land
2/ Price Base: 1963

March 1965

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At time of work plan preparation)

Frogville Creek Watershed, Oklahoma

Measures	Unit	Number Applied to Date	Total 1/ Cost (dollars)
LAND TREATMENT			
Conservation Cropping System	Acre	2,741	2,741
Contour Farming	Acre	119	238
Cover and Green Manure Crop	Acre	1,475	12,538
Crop Residue Use	Acre	2,678	6,695
Drainage Field Ditch	Feet	146,172	9,794
Drainage Main or Lateral	Feet	54,293	10,859
Farm Pond	Number	16	6,400
Fish Pond Stocking	Number	10	30
Fish Pond Management	Number	2	12
Land Clearing	Acre	944	37,760
Land Smoothing	Acre	185	1,110
Pasture and Hayland Renovation	Acre	357	7,497
Pasture and Hayland Planting	Acre	1,570	40,820
Pasture Proper Use	Acre	1,404	1,404
Wildlife Habitat Development	Acre	120	600
TOTAL	xxx	xxx	138,498

1/ Price Base: 1963

March 1965

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Frogville Creek Watershed, Oklahoma

(Dollars) 1/

Structure Site No. or Name	Installation Cost - Public Law 566 Funds				Installation Cost - Other				Total Installation Cost
	Construction	Installation Services: Engineering	Installation Services: Other	Total Public Law 566	Construction	Adm. of Contracts	Easements & R/W	Total Other	
1	37,950	7,210	2,981	48,141	-	400	9,910	10,310	58,541
2	35,750	6,793	2,808	45,351	-	400	6,620	7,020	52,371
Subtotal	73,700	14,003	5,789	93,492	-	800	16,530	17,330	110,822
Mains, Laterals & Appurtenant Structures									
Main No. 1 and Laterals									
1A and 1B	130,705	28,523	11,782	171,010	19,418	1,100	46,803	67,321	238,331
Main No. 3	5,449	1,137	470	7,056	533	100	12,810	13,443	20,499
Main No. 4	24,613	5,226	2,159	31,998	2,892	500	17,700	21,092	53,090
Main No. 5 & Lateral 5B	29,389	6,334	2,616	38,339	3,951	550	16,420	20,921	59,260
Subtotal	190,156	41,220	17,027	248,403	26,794	2,250	93,733	122,777	371,180
GRAND TOTAL	263,856	55,223	22,816	341,895	26,794	3,050	110,263	140,107	482,002

1/ Price Base: 1963 Prices

March 1965

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY
Frogville Creek Watershed, Oklahoma

(Dollars) 1/

Item	Purpose: Flood Prevention	Purpose: Drainage	Total
Single Purpose			
Floodwater Retarding Structures	110,822	-	110,822
Multiple Purpose			
Mains, Laterals and Appurtenant Structures	280,663	90,517	371,180
TOTAL	391,485	90,517	482,002
COST SHARING			
Public Law 566	300,714	41,181	341,895
Other	90,771	49,336	140,107
TOTAL	391,485	90,517	482,002

1/ Price Base: 1963 Prices

March 1965

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES
Frogville Creek Watershed, Oklahoma

Item	Unit	Structure Number 1	2 3/	Total
Drainage Area	Sq.Mi.	1.09	1.08	2.17
Storage Capacity 1/				
Sediment (1st 50-years)	Ac.Ft.	19	-	19
Sediment (2nd 50-years)	Ac.Ft.	25	42	67
Sediment in Detention	Ac.Ft.	7	10	17
Floodwater Detention	Ac.Ft.	304	305	609
Total		355	357	712
Surface Area 1/				
Sediment Pool (50-year)	Acre	7	-	7
Sediment Pool (100-year)	Acre	14	10	24
Detention Pool	Acre	59	48	107
Volume of Fill	Cu.Yds.	55,000	51,000	106,000
Elevation Top of Dam 1/	Foot	432.7	443.5	
Max. Height of Dam 1/	Foot	23.0	30.0	
Emergency Spillway				
Crest Elevation 1/	Foot	429.7	440.5	
Bottom Width 1/	Foot	40	40	
Type		Veg.	Veg.	
Percent Chance of Use		4	4	
Future Curve No. Cond. II		74	74	
Emergency Spillway Hydrograph				
Storm Rainfall (6-hour)	Inch	5.6	5.6	
Storm Runoff	Inch	2.86	2.86	
Velocity of Flow (Vc)	Ft./Sec.	-	-	
Discharge Rate	C.F.S.	-	-	
Max. Water Surface Elev.	Foot	-	-	
Freeboard Hydrograph				
Storm Rainfall (6-hour)	Inch	14.2	14.2	
Storm Runoff	Inch	10.72	10.72	
Velocity of Flow (Vc)	Ft./Sec.	7.2	7.4	
Discharge Rate	C.F.S.	454	500	
Max. Water Surface Elev.	Foot	432.5	443.5	
Principal Spillway Capacity	C.F.S.	20	20	
Sediment Pool Elev. (50-year)	Foot	418.5	-	
Sediment Pool Elev. (100-year)	Foot	420.7	428.5	
Capacity Equivalents				
Sediment Pool (1st 50-years)	Inch	0.32	-	
Sediment Pool (2nd 50-years)	Inch	0.43	0.74	
Sediment Detention Pool	Inch	0.12	0.17	
Detention Volume 2/	Inch	5.23	5.29	
Spillway Storage	Inch	3.42	2.85	
Class of Structure		A	A	

1/ Subject to minor adjustments in the final design stage. Major changes will require a work plan revision.

2/ Based on regional analysis of gaged runoff in all cases exceeds minimum requirements set forth in Washington Engineering Memorandum SCS-27.

3/ Authority granted to set riser at 100-year sediment storage elevation.

March 1965

TABLE 3A - STRUCTURE DATA

GRADE STABILIZATION STRUCTURES
Frogville Creek Watershed, Oklahoma

Channel Number	Drainage Area (acres)	Drop (feet)	Earth Fill (cu.yds.)	Type Structure
Channel No. 1				
(4 similar structures)	110	6	350	CMP - drop
(2 similar structures)	300	6	500	CMP - drop
(1 similar structure)	400	6	600	CMP - drop
(2 similar structures)	70	4	250	CMP - drop
(4 similar structures)	40	6	200	CMP - drop
(10 similar structures)	60	6	200	CMP - drop
(2 similar structures)	160	6	400	CMP - drop
Channel No. 3				
(3 similar structures)	40	2	200	CMP - drop
Channel No. 4				
(1 similar structure)	180	5	450	CMP - drop
(2 similar structures)	120	4	350	CMP - drop
(6 similar structures)	40	4	200	CMP - drop
(1 similar structure)	320	4	500	CMP - drop
(1 similar structure)	260	4	500	CMP - drop
Channel No. 5				
(3 similar structures)	60	4	200	CMP - drop
(2 similar structures)	40	4	200	CMP - drop
(1 similar structure)	160	4	400	CMP - drop
(1 similar structure)	200	4	400	CMP - drop

March 1965

TABLE 3B - STRUCTURE DATA

CHANNELS

Frogville Creek Watershed, Oklahoma

Channel Designation	Station Numbering for Reach 1/: Station (100 ft.)	Station (100 ft.)	4/ Watershed Area (acres)	2/ 3/ Required Capacity (cfs)	Planned Channel Capacity (cfs)	Average Bottom Width (feet)	Average Side Slope	Average Depth (feet)	Average Grade (ft./ft.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu.yds.)
Main Ditch No. 1	299+50	290+00	224	84	86	4.0	1½:1	3.4	0.0030	2.77	1.58
	290+00	268+00	537	190	185	6.0	1½:1	4.1	0.0030	3.65	4.80
	268+00	249+50	673	233	237	10.0	1½:1	5.6	0.00075	2.30	11.09
	249+50	211+50	1135	375	379	10.0	1½:1	6.6	0.00075	2.88	25.72
	211+50	188+50	1486	465	480	16.0	1½:1	8.0	0.00030	2.15	18.33
	188+50	151+50	2107	670	682	16.0	1½:1	8.8	0.00030	2.64	44.39
	151+50	90+00	2627	820	817	16.0	1½:1	9.7	0.00030	2.77	78.66
	90+00	39+00	2870	875	874	16.0	1½:1	10.0	0.00030	2.82	33.49
Main Ditch No. 3	109+50	75+50	126	45	52	6.0	1½:1	2.8	0.00095	1.80	0.43
	66+00	54+50	412	143	140	8.0	1½:1	3.6	0.0020	2.90	0.65
	54+50	39+50	530	187	189	8.0	1½:1	4.2	0.0020	3.14	2.69
	39+50	20+00	1243	435	427	16.0	1½:1	4.6	0.0020	4.12	5.36
Main Ditch No. 4	170+00	152+50	404	143	146	6.0	1½:1	3.7	0.0030	3.44	4.00
	152+50	140+00	744	270	277	8.0	1½:1	4.6	0.0030	4.04	3.48
	140+00	120+00	848	305	305	10.0	1½:1	5.0	0.0020	3.53	5.43
	120+00	103+50	1100	390	395	16.0	1½:1	6.0	0.00060	2.62	8.06
	103+50	64+00	1275	450	446	16.0	1½:1	6.4	0.00060	2.71	18.05
Main Ditch No. 5	169+00	161+00	598	208	217	10.0	1½:1	3.2	0.0030	4.59	0.43
	161+00	148+00	948	332	328	16.0	1½:1	5.4	0.00060	2.49	6.75
	148+00	78+00	1419	500	495	20.0	1½:1	5.7	0.00060	3.06	34.17

4-19678 3-65

TABLE 3B - STRUCTURE DATA - Continued

CHANNELS
Frogville Creek Watershed, Oklahoma

Channel Designation	Station Numbering 1/ for Reach: Station (100 ft.)	Station (100 ft.)	4/ Watershed Area (acres)	2/ 3/ Required Capacity (cfs)	Planned Channel Capacity (cfs)	Average Bottom Width (feet)	Average Side Slope	Average Depth (feet)	Average Grade (ft./ft.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu.yds.)
Laterals											
1A	47+80	34+99	100	36	38	4.0	4:1	2.9	0.00035	0.85	3.24
1A	34+99	1+00	240	84	87	4.0	4:1	4.1	0.00035	1.05	17.68
1B	21+00	0+00	50	23	23	V	4:1	2.3	0.0010	1.11	2.56
5B	25+20	0+00	360	125	127	4.0	4:1	4.1	0.00080	1.53	8.84

1/ All main and lateral stationing from lower end.

2/ Required capacities determined from National Engineering Handbook, Section 4, Supplement A, Chapter 16.

3/ Includes release rates of floodwater retarding structures.

4/ Uncontrolled drainage area.

March 1965

TABLE 4 - ANNUAL COST

Frogville Creek Watershed, Oklahoma
(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Reach No.1			
Floodwater Retarding Structure No. 2, Main Channel No. 1, Laterals 1A & 1B and Appurtenant Structures	9,524	7,559	17,083
Reach No. 3			
Main Channel No. 3 and Appurtenant Structures	672	642	1,314
Reach No. 4			
Floodwater Retarding Structure No. 1, Main Channel No. 4 and Appurtenant Structures	3,657	1,759	5,416
Reach No. 5			
Main Channel No. 5, Lateral 5B and Appurtenant Structures	1,941	1,856	3,797
TOTAL	15,794	11,816	27,610

1/ Price Base: 1963 Prices. Amortized over 100-years at 3.125 percent interest.

2/ Long-term prices, as projected by ERS, September 1957. Includes allowance of $9,454 annually for replacement of facilities.

March 1965

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Frogville Creek Watershed, Oklahoma

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Crops and Pastures	41,729	686	41,043
Total	41,729	686	41,043

1/ Price Base: Long-term as projected by the ARS, September 1957.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
Frogville Creek Watershed, Oklahoma
(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS						Average Annual Cost	Benefit Cost Ratio
	Flood Prevention		Agricultural Water Management Drainage	Secondary	Redevelopment	Total		
	Damage Reduction	More Intensive Land Use						
Reach No. 1 Floodwater Retarding Structure No. 2, Main Channel No. 1, Laterals 1A & 1B and Appurtenant Structures	21,365	16,449	5,740	6,107	1,391	51,052	17,083	3.0/1
Reach No. 3 Main Channel No. 3 and Appurtenant Structures	4,144	5,159	1,118	1,225	99	11,745	1,314	8.9/1
Reach No. 4 Floodwater Retarding Structure No. 1, Main Channel No. 4 and Appurtenant Structures	6,406	3,034	808	1,172	528	11,948	5,416	2.2/1
Reach No. 5 Main Channel No. 5, Lateral 5B and Appurtenant Structures	8,856	5,441	1,690	2,309	285	18,581	3,797	4.9/1
TOTAL	40,771 2/	30,083	9,356	10,813	2,303	93,326	27,610	3.4/1

1/ Benefits, long-term as projected by ERS, September 1957. Costs, based on 1963 prices for installation costs and long term as projected by ERS, September 1957, for operations and maintenance.

2/ Additional benefits of $272 from land treatment were not included in this total and were not used for project justification.

INVESTIGATIONS AND ANALYSES

Soil and Cover Conditions

The soil-cover determinations were made from existing work unit records, soil surveys, and field inspection.

Land Use and Treatment Needs

The procedure for determining the land use and land treatment to be applied during the installation period and for estimating the cost of application was as follows:

1. The major land uses of the bottomland by soil units was determined from soil and field survey. This information for the upland was obtained from work unit data.

2. Estimate was made of the acres with essential conservation practices applied.

3. Land treatment goals to be achieved by the end of the project installation period for each land use item within soil units were established.

4. The acres to be treated during the project installation period was determined from work unit records.

5. The cost of applying a composite acre of conservation treatment for each land use by soil capabilities was established by work unit records.

6. The costs established in step 5 were applied to the acres from step 4 to arrive at the costs of applying the conservation land treatment practices to be applied during the installation period.

7. Technical assistance needs for accelerating the application of land treatment practices were determined from work unit needs and personnel wage data.

Engineering Investigations

A base map was prepared showing the watershed boundary, drainage pattern, system of roads and other pertinent information. Four inch aerial photographs were available for use in locating structural measures, drainage boundaries and etc. U. S. C. G. bench mark data were obtained for location of bench marks.

A stereoscopic study of consecutive 4 inch aerial photographs was used to locate possible floodwater retarding structure sites. A field ex-

amination was made of all floodwater retarding structure sites previously located stereoscopically. A total of two sites were investigated. A visual investigation of the channels was made at road crossings, below structures, at intermittent locations and at all outlets.

Surveys for vertical and horizontal control were made for all floodwater retarding structures, channel improvement and hydraulic cross sections. Valley cross sections were surveyed approximately one half mile apart on all channels. Cross sections for channel improvement were approximately 1,000 feet apart. Complete topographic surveys were made on each floodwater retarding structure and a topographic map with 4 foot contour intervals and a horizontal scale of 1 inch = 200 feet was developed from engineering surveys of the pool area. All surveys were made to an accuracy of at least 3.0'/1000' horizontal and 0.1' $\sqrt{\text{miles}}$ vertical.

Field surveys were made of all channels which are to be included in the project. A normal ground profile was developed for each channel, using the channel cross sections and hydraulic valley sections. The needed channel capacity was determined from Section 4, Supplement A, National Engineering Handbook using a 5-year, 12-hour storm.

Storage curves (developed from topographic maps), hydrograph work sheets, emergency spillway chart and table for embankment yardage were used in the design of the floodwater retarding structures. Hydraulic tables (developed by the Corps of Engineers), and Section 16-SCS National Engineering Handbook for drainage, and Section 4, Supplement A, National Engineering Handbook were used in the design of channels. Engineering Memorandum OK-10, OK-22, OK-33 and SCS-27 were used in developing the designs.

The height of the dams and the size of the pools were determined by the storage volume needed to detain the runoff from the design storm and to provide the additional storage needed for sediment accumulation in the floodwater retarding structures. Structural data tables were developed to show the drainage area, storage capacity planned for floodwater detention, sediment, release rates of principal spillway, emergency spillway capacity, area inundated by the pools, and other pertinent data for each structure (Table 3). Structural data tables were developed to show the drainage area, planned channel capacity, average bottom width, average side slope, average depth, average grade, average velocity in the channel and the volume of excavation of each channel (Table 3A).

The embankment volume (for each floodwater retarding structure) was computed using yardage chart developed for embankment volume computations. The volume of excavation (for each channel) was computed by the average end area method.

Cost estimates were made based on construction cost in similar areas (for floodwater retarding structures and channel improvement). Allowances were made for high cost of clearing in the densely timbered

areas. Checks were made to determine if additional detention storage would reduce the over-all cost of the embankment, cut off, and emergency spillway.

The operation and maintenance costs were based on the construction cost of the structures and channel.

Hydraulic and Hydrologic Investigations

The following steps were taken as part of the hydraulic and hydrologic investigations and determinations.

1. Basic meterologic and hydrologic data from climatological bulletins, U. S. Weather Bureau, and Water Supply Papers, U. S. Geological Survey, were analyzed to determine average precipitation; the historical flood series to evaluate a portion of the project; runoff-peak discharge relationships; and the relationship of geology, soils and climate to runoff depth for single storm events.

2. Engineering surveys were made of channel and valley cross sections selected to represent adequately the stream hydraulics and the flood plain area. Preliminary locations for cross sections were made by stereoscopic examination of aerial photographs of the flood plain. The final locations were selected in the field, giving due consideration to the needs of the economist and geologist (figure 4).

3. A 20-year historical storm series was tabulated from 50-years of rainfall records at Hugo, Oklahoma. Based on cumulative departures from normal, the period 1942 through 1961, inclusive, was selected as a period of normal rainfall.

4. The present hydrologic condition of the watershed was determined by classifying the soil in hydrologic groups with the assistance of the soil scientist. A reconnaissance survey of the watershed was made with the planning staff geologist to obtain additional data as to hydrologic cover condition.

   The future hydrologic condition of the watershed was determined from information furnished by the work unit conservationist concerning the changes in land use that could be expected from an accelerated land treatment program during the installation period. Runoff curve numbers were computed from the soil cover complex data and used with figure 3.10-1, NEH, Section 4, Supplement A to determine the depth of runoff for storms of various magnitudes. Seasonal soil moisture indices were used.

5. Unit hydrographs were developed for the incremental areas using the procedure in National Engineering Handbook, Section 4, Supplement A, Chapter 16. The duration of excess rainfall used in the equation $Q = \frac{484\ A}{D/2 + 0.6\ Tc}$ was assumed to be equal to Tc. These unit hydrographs were used to develop composite hydrographs of the runoff produced by 5 and 25 year, 12-hour frequency storms.

6. Rating curves, area-inundated curves by depth increments, and hydraulic parameters were developed for each valley section by use of an IBM 650 electronic computer. These were computed twice, first under present conditions and then with an improved channel in place.

7. Runoff-peak discharge relationships were computed by the coefficient method of stream reach routing.

   Without Project: The 25-year storm was routed and the peak discharge for the various storms in the evaluation series were considered proportional to the volume of runoff.

   With Project: The 5 and 25 year storms were routed and the peak discharges for the various storms in the evaluation series were considered proportional to the volume of runoff.

   The discharge from each site was added appropriately to the hydrographs from the uncontrolled drainage areas and routed through the stream reaches.

   This procedure was applied to reaches 1, 4 and 5 of the four hydrologic reaches. Due to the topography and nature of reach 3, flood routing procedures were not applicable (figure 4).

8. Depth increment determinations were made of the flood plain that would have been inundated by each storm in the evaluation series under conditions that would exist under:

   a. Present conditions.
   b. With the installation of land treatment measures.
   c. With the installation of land treatment measures and channel improvement.
   d. With the installation of land treatment measures, channel improvement and floodwater retarding structures.

9. Engineering and Watershed Planning Unit Hydrology Memorandum No. 2, (Ok Engr. 35) was used to determine the detention storage for the structures. The minimum storage requirement of 2.85 inches for class (a) structures, set forth by Washington Engineering Memorandum 27, which is the runoff from the 6-hour, 25-year frequency storm (Weather Bureau Technical Publication 40) was exceeded in the floodwater retarding structures.

10. The appropriate spillway design storm and storm pattern were selected from figures 3.21-1, 3.21-4 and 5, National Engineering Handbook, Section 4, Supplement A, in accordance with criteria contained in Engineering Memorandum SCS-27. (OK Engr. 22).

    Spillway design storm hydrographs were developed for each of the floodwater retarding structures by the distribution graph method.

    Various combinations of emergency spillway elevation, width and depth were computed by an empirical equation. Cost estimates were made of the various combinations to determine the most economical structure.

    A maximum release rate was coordinated with site storage and provides a reasonable emptying time for the detention pool.

11. Channel capacities for the improved channels were designed to carry the peak discharge of a 12-hour, 5-year frequency storm from the uncontrolled area. The maximum release flows were added to the discharge from the uncontrolled drainage areas in the appropriate reach to obtain design channel capacity.

    Hydrographs were developed for the design storm in item 5 above and routed to arrive at the peak rate of discharge. The discharge rate for reach 3 was determined by using the relationship of drainage area to peak discharge as derived in the routing of reach 5.

Sedimentation Investigations

The field surveys of the sedimentation problems of the Frogville Creek Watershed were made in accordance with the Geologic Section of the Oklahoma Planning Handbook and Technical Release No. 12, "Procedure for Computing Sediment Requirements for Retarding Reservoirs" (September 1959).

Field studies included reconnaissance surveys of geology and physi-

ography, studies of overbank sediment deposits, flood plain scour, streambank erosion and the nature of the channels on or near the valley cross sections. Borings were made along or near 40 percent of the valley sections to determine the extent, depth and texture of sediment deposits. Sediment deposits are very minor and no damages were estimated.

Soil samples were taken from each of the four channels with a hydraulic soil push tube. Examination of the samples showed the soil material to be very similar in all of the channels. Because of the great similarity of the soil material composite samples from each of the channels were sent to the laboratory for analyses.

Laboratory tests included hydrometer analysis, total salt, dispersion and Atterbury limits. The tractive force and critical tractive force were determined from the laboratory analyses. The chart developed by the Ft. Worth Engineering and Watershed Unit (for cohesive soils) was used for selection of a channel design which would insure relatively stable conditions with a minimum amount of maintenance.

Sediment Source Studies

Sediment sources were investigated in the drainage areas of one of the two planned floodwater retarding structures. Procedures outlined in the Oklahoma Watershed Planning Handbook and Technical Release No. 12 were followed. Using results of these investigations, estimates were made of the present and future sediment yields to the other floodwater retarding site. It is estimated that 95 percent of the total annual sediment production in the watershed is from upland sheet erosion. The remaining sediment is from roads, 2 percent; miscellaneous areas, 1 percent and small gullies, 2 percent. There are no critical sediment source areas in the watershed. A small amount of aggradation has occurred in the upper ends of channels 1 and 4 but increased flooding because of this is negligible. Both of the floodwater retarding structures have been planned with 100-year sediment pools. Site No. 2 will be used for recreational purposes and the riser will be set at the 100-year sediment pool elevation to alleviate undersirable impoundment.

Geologic Investigations

Preliminary geologic investigations were made at all of the planned structure locations. Observations were made as to the kind of material in the abutments, the foundations, and the kinds of soils available in areas of borrow material. Only two geologic ages are represented in the watershed. The area in the upper end of the watershed consists of sandy terraces of Pleistocene age. The bottomland areas are Recent alluvium. Borings were also made along the hydrologic cross sections of each one of the four channels. Almost all of the soils in the channels are heavy CL or CH material. No dispersed soil materials were found during the investigations but there is a possibility that some may be encountered in excavation of the channels, which would require special stabilization

methods.

There appears to be no geologic conditions at either of the floodwater retarding structure sites which would adversely affect the cost of construction. Sufficient fill material of suitable quality is available at each location. A water table may be encountered in the sediment pool area which will make it necessary to obtain fill material from the side slopes immediately above the site location. Most of the material for the embankment will be SM and SC with minor amounts of CL.

Foundation drains will probably be needed in each of the floodwater retarding structures and have been included in cost estimates. Detailed geologic investigations and laboratory testing of soil materials will be made before the structures are finally designed.

Detailed core drilling will be needed at each of the sites prior to construction.

Various geologic conditions at each site are described on Form SCS-375, "Preliminary Geologic Investigation on Dam Sites". These are on file as a part of the work plan substantiating data.

Economic Investigations

The procedures outlined in the National Economic Guide were followed in the economic investigation. The following basic data tables have been developed in the process of preparing the work plan:

1. Acreage of various soil units within hydrologic or construction units.

2. Land use and production by soil units without project.

3. Land use and production by soil units after project installation.

4. Present land use and production, by hydrologic unit, showing net return (long-term prices).

5. Future land use and production, by hydrologic unit, showing net return (long-term prices).

6. Production cost for various crops in the watershed.

7. Costs associated with clearing woods pasture and utilizing it as cropland and improved pasture.

8. Net returns from pasture were based on the value of animal unit months of grazing produced under present conditions and expected future yields with the project installed.

Damage schedules covering 83 percent of the project area were obtained in the field. Present land use and yields, and expected land use and yields after project installation, were determined by interviews and by field inspection. Information from these sources was correlated with data obtained from soils technicians and soils survey maps.

To facilitate evaluation, the watershed was divided into four hydrologic reaches. Floodwater damages and benefits were calculated for reaches 1, 4 and 5 using flood routings supplied by the hydrologist. The flat terrain of reach 3 provided no basis for hydrologic flood routing. On the basis of these routings crop and pasture damages and benefits were computed for the three reaches routed. The cost of harvesting and other expenses saved were deducted from the gross value of the damage in the calculation of crop and pasture damage. Adjustments for recurring flooding were also made. Road and bridge damages were minor, therefore, no attempt was made to evaluate them. Sediment and scour damages were also negligible, so were not calculated.

In anticipation of the project, farmers of the Frogville Creek Watershed utilized the dry seasons of 1963 and 1964 to clear much of the remaining brushy bottomlands of the area. Without exception, all farmers interviewed in the course of this study indicated they would clear all brushy bottomland areas and convert them to cropland or improved pasture. Land in the area is selling upward of $300 per acre. Therefore, in evaluating the benefits from the project it was assumed that 100 percent participation would occur within a ten year period following the inception of the project. In accordance with this assumption all enhancement type benefits were adjusted for a ten year lag in establishment of the project and full realization of the benefits of on-farm drainage and re-organization of cropping systems.

Table A as included in this plan is a combined table of individual Table A's prepared for each of the four reaches. It illustrates the procedure used in developing the individual tables. Associated costs, such as clearing costs and increased taxes and overhead, were deducted in arriving at the net benefits. Increased production benefits on 1,270 acres of Red River alluvium that floods because of lack of outlets were calculated as a part of Table A. Since this land is not inherently wet these benefits were assigned to flood prevention and included in Table 5. The remaining benefits (Table A) were allocated between more intensive land use and drainage according to the cost of structural measures producing them.

Secondary benefits were calculated as 10 percent of the net returns from the project, increased direct production costs, and the expense associated with land clearing. Since there is an alfalfa dehydrating plant operating close by the project area, this is a conservative estimate of secondary benefits - a 20 percent factor might have been

applied for increased alfalfa production.

The installation of the project will provide an opportunity for the employment of local labor presently unemployed or underemployed. Data from sililar projects in the area indicate that local labor costs approximate 14 percent of the installation costs. This value for the costs of installation of the structural measures in the Frogville Creek Watershed was amortized and converted to a redevelopment benefit. Likewise the value of local labor employed in project operation and maintenance over a 20-year period was converted to an average value for the project life and used as a second redevelopment benefit.

TABLE A - BENEFITED AREA: LAND USE, YIELDS, AND VALUE OF PRODUCTION WITH AND WITHOUT PROJECT

Frogville Creek Watershed, Oklahoma

Land Use Without Project

Land Use	Acre	Unit	Yield Per Acre	1/ Gross Income	Production Cost	Net Return
				(dollars)	(dollars)	(dollars)
Alfalfa	1,103	Ton	4.17	110,715	37,060	73,655
Corn	325	Bu.	70	32,077	11,539	20,538
Cotton	327	Lb.	625	47,008	35,970	11,038
Combine Milo	121	Cwt.	40	9,051	2,680	6,371
Other Hay	59	Ton	3	3,983	1,752	2,231
Improved Pasture	728	AUM	8	25,043	14,124	10,919
Pastured, Woodland	917	AUM	1	3,943	-	3,943
Miscellaneous	70		-	-	-	-
Total	3,650			231,820	103,125	128,695

Land Use With Project

Alfalfa	2,068	Ton	4.72	235,193	69,485	165,708
Corn	55	Bu.	75	5,817	2,054	3,763
Cotton	327	Lb.	750	56,409	35,960	20,449
Combine Milo	31	Cwt.	40	2,319	687	1,632
Improved Pasture	1,087	AUM	9	42,133	21,091	21,042
Miscellaneous	82		-	-	-	-
Total	3,650			341,871	129,277	212,594

Increased net return with project	83,899
Adjusted for associated costs 2/	79,156
Adjusted for 10-year lag .818	64,750
Average annual benefits	64,750 3/

1/ Long-term prices, as projected by ERS, September 1957
2/ Clearing woodland and increased taxes and overhead included.
3/ Floodwater reduction benefits estimated at $25,311; drainage at $9,356 and more intensive land use at $30,083.

March 1965

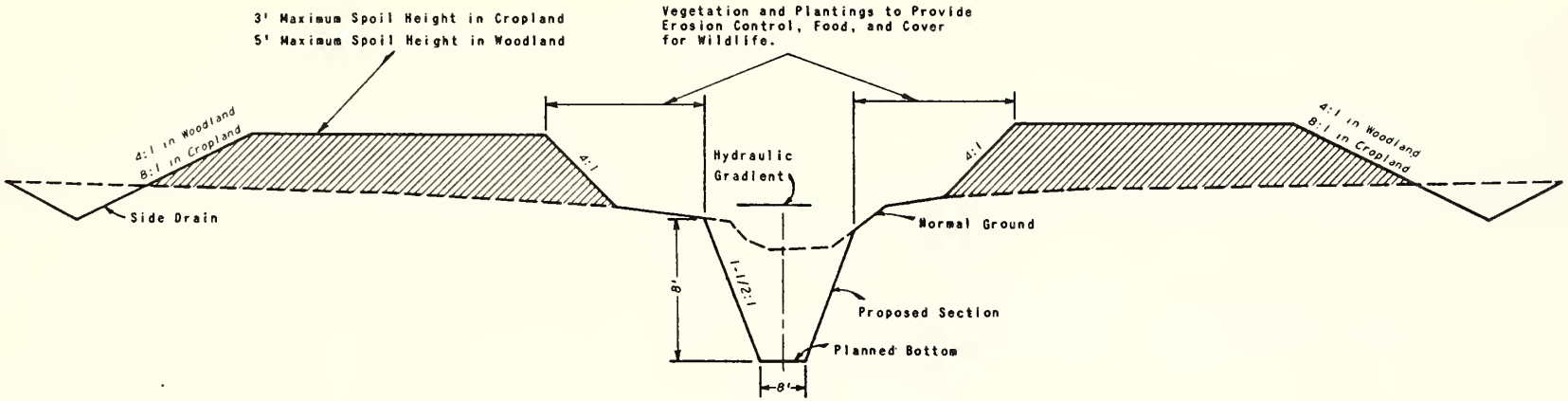


Figure 1A

TYPICAL CHANNEL CROSS SECTION
FROGVILLE CREEK WATERSHED

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Stillwater, Oklahoma

8-64 4-L-18715

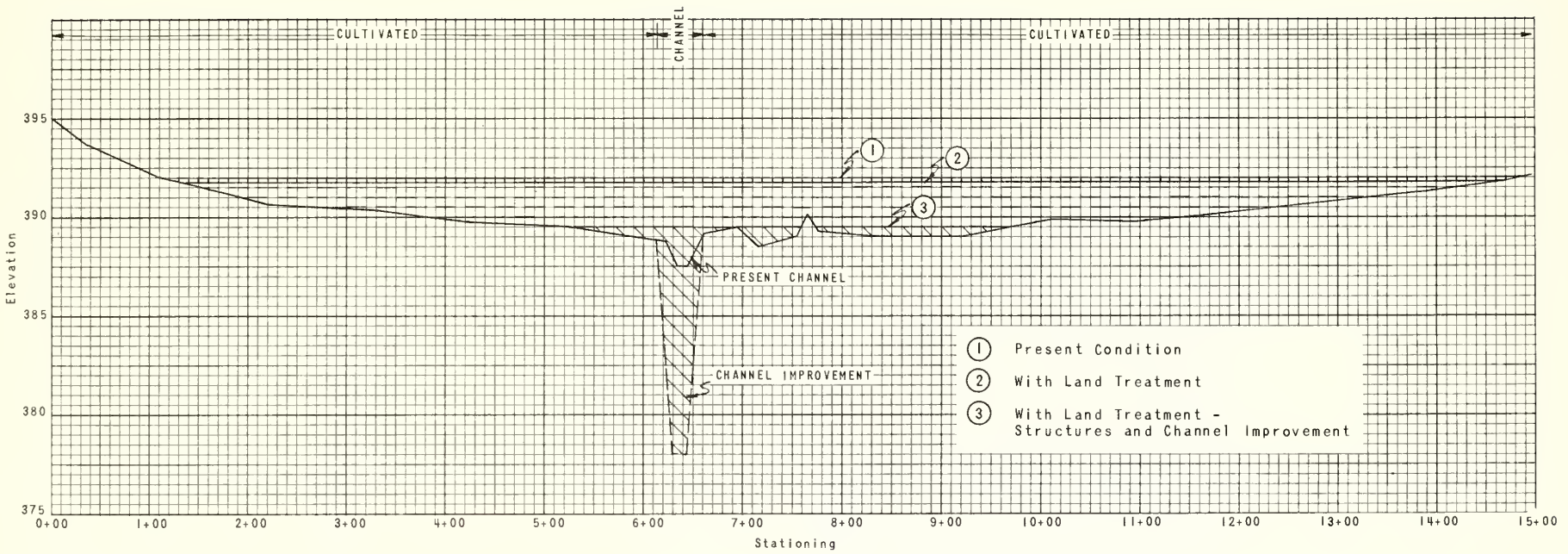


Figure 2

DEGREE OF FLOOD REDUCTION

FROGVILLE CREEK

STORM OF SEPTEMBER 30, 1954

DURATION OF STORM WAS 24 HOURS

5.18 INCHES OF RUNOFF

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Stillwater, Oklahoma
4-1967 3-65
USDA-SCS-FORT WORTH, TEX. 1995

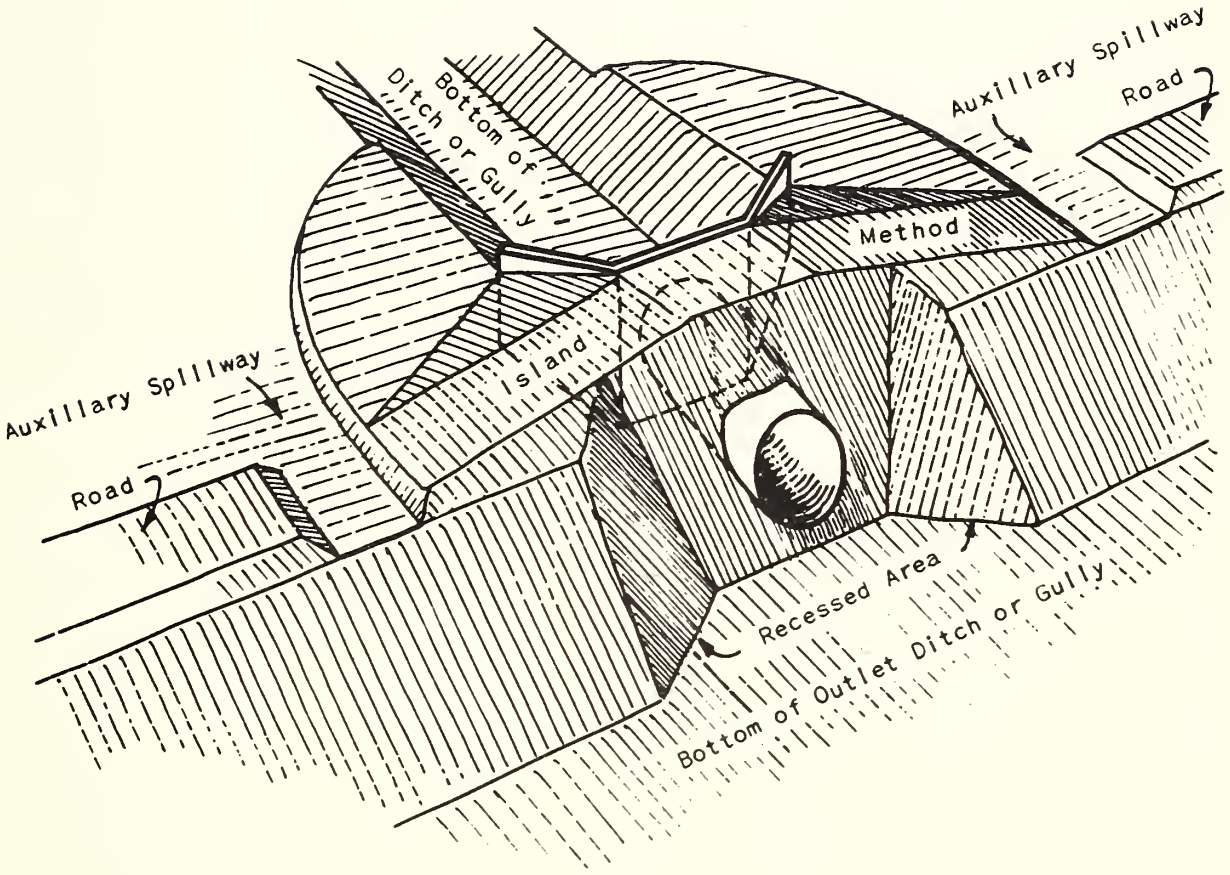


Figure 2A

TYPICAL PIPE DROP STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE 1-64 4-L-18550

4-19878 3-65

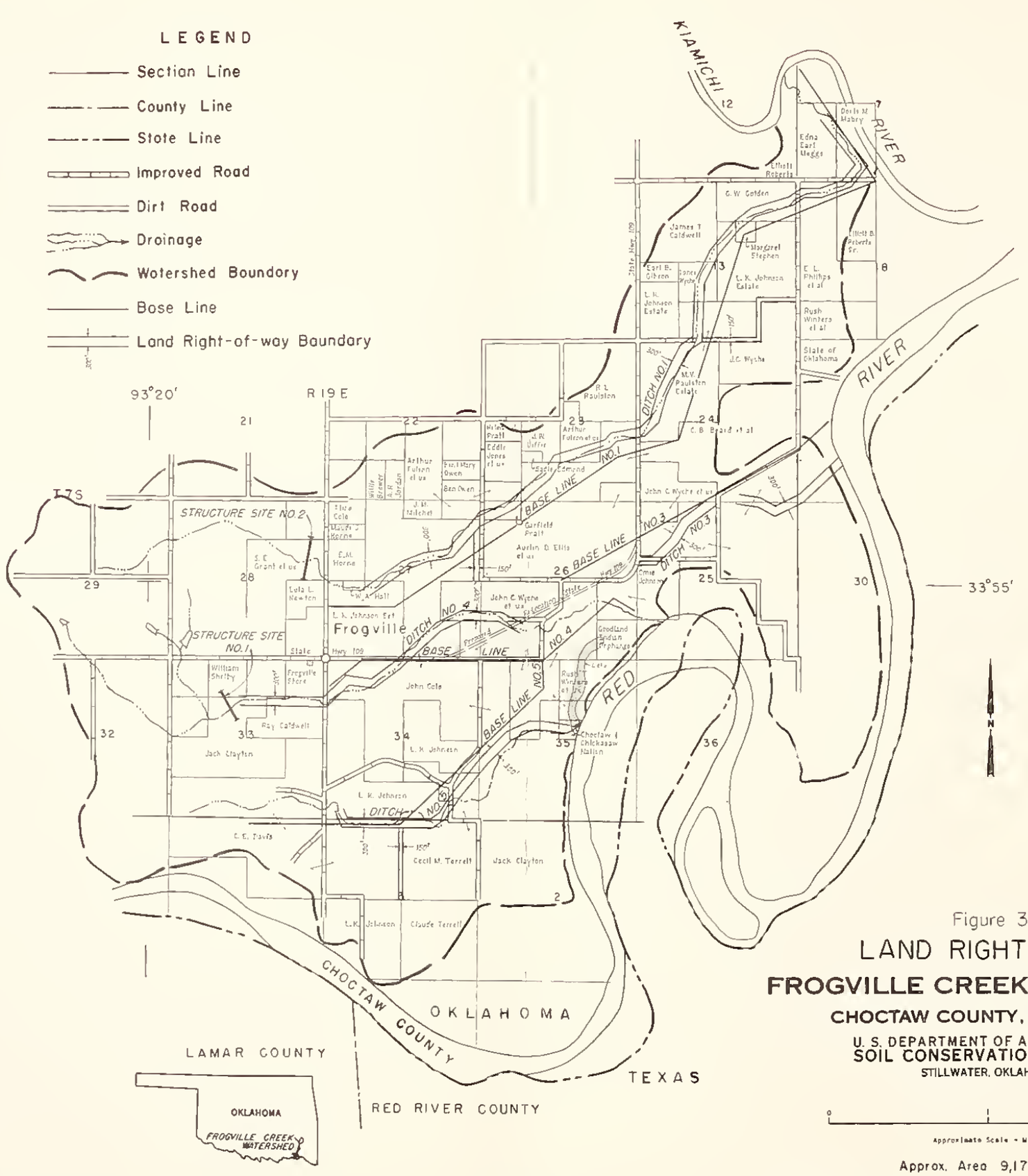


Figure 3

LAND RIGHTS MAP

FROGVILLE CREEK WATERSHED

CHOCTAW COUNTY, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

0 1 2
Approximate Scale - Miles

Approx. Area 9,171 Acres

Base Compiled from Mosaic 4-R-17917

Revised 3-65	8-64	4-R-18734
June 4, 1963	Revised 8-64	4-R-17944

USDA-SCS-FORT WORTH, TEX. 6865

Figure 4

PROBLEM LOCATION

FROGVILLE CREEK WATERSHED

CHOCTAW COUNTY, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

0 1 2

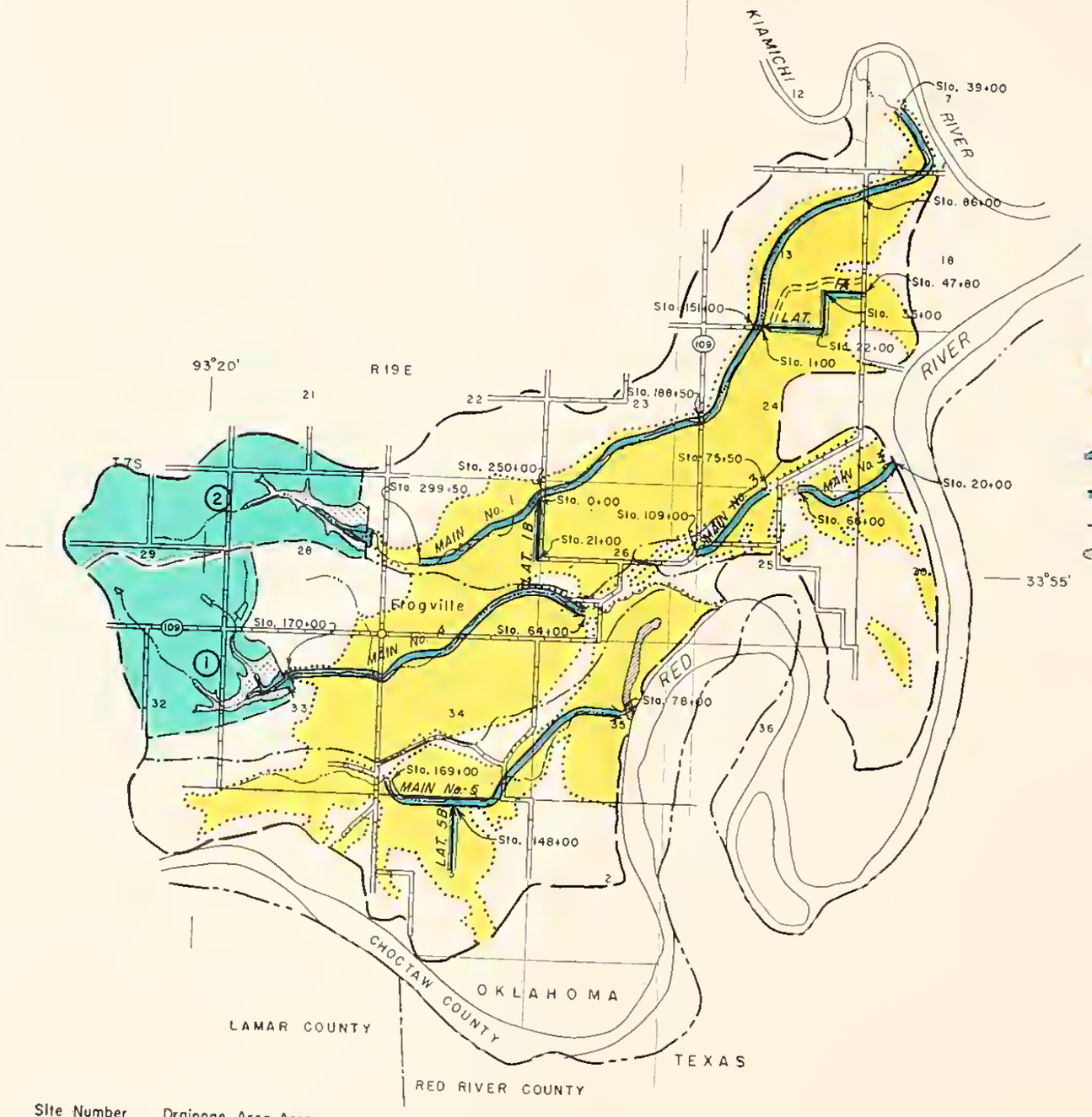
Approximate Scale - Miles

Approx. Area 9,171 Acres

Base Compiled from Mosaic 4-R-17917

June 4, 1963 Revised 8-64 Revised 3-65 8-64 4-R-17944 4-R-18731

USDA-SCS-FORT WORTH, TEX. 1965



LEGEND

- Section Line
- County Line
- State Line
- Improved Road
- Dirt Road
- Drainage
- Watershed Boundary
- Floodwater Retording Structure
- Drainage Area Controlled by Structure
- Area Benefited
- (2) Site Number
- Main Drainage Ditch
- Laterol Drainage Ditch
- Boundory Between Main Ditches
- Existing Lake

Site Number	Drainage Area Acres
1	698
2	692

Figure 5

PROJECT MAP
FROGVILLE CREEK WATERSHED

CHOCTAW COUNTY, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

Approximate Scale - miles

Approx. Area 9,171 Acres

Base Compiled from Mosaic 4-R-17917

USDA-SCS-FORT WORTH, TEX, 1965

Revised 3-65 8-64 4-R-18728
June 4, 1963 Revised 8-64 4-R-17944

WATERSHED WORK PLAN AGREEMENT

between the

Kiamichi Soil and Water Conservation District
Local Organization

Frogville Conservancy District No. 1
Local Organization

_____
Local Organization

_____

_____

State of Oklahoma
(hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Frogville Creek Watershed, State of Oklahoma under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Frogville Creek Watershed, State of Oklahoma, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 5 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire such land, easements or rights-of-way as will be needed in connection with the works of improvement. (Estimated Cost $ 110,263). The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Land, Easements, and Rights-of-Way Cost (dollars)
Floodwater Retarding Structures, Main Ditches and Laterals	100	0	110,263

2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures	0	100	73,700
Main Ditch 1, Laterals and Appurtenances	12.94	87.06	150,123
Main Ditch 3, Laterals and Appurtenances	8.91	91.09	5,982
Main Ditch 4, Laterals and Appurtenances	10.51	89.49	27,505
Main Ditch 5, Laterals and Appurtenances	11.85	88.15	33,340

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
Floodwater Retarding Structures, Main Ditches, Laterals & Appurtenances	0	100	78,039

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 3,050 .)

6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

13. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

14. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.13), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

Kiamichi Soil and Water Conservation District
Local Organization

By Walter B Hall

Title Chairman

Date 4-6-65

The signing of this agreement was authorized by a resolution of the governing body of the Kiamichi Soil and Water Conservation District
Local Organization

adopted at a meeting held on April 6, 1965

P. J. Schell Jr.
(Secretary, Local Organization)

Date 4-6-65

- -

Frogville Conservancy District No. 1
Local Organization

By Charles B. Burns

Title Chairman

Date 4-6-65

The signing of this agreement was authorized by a resolution of the governing body of the Frogville Conservancy District No. 1
Local Organization

adopted at a meeting held on April 6, 1965

John W. Phillips
(Secretary, Local Organization)

Date 4-6-65

- -

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

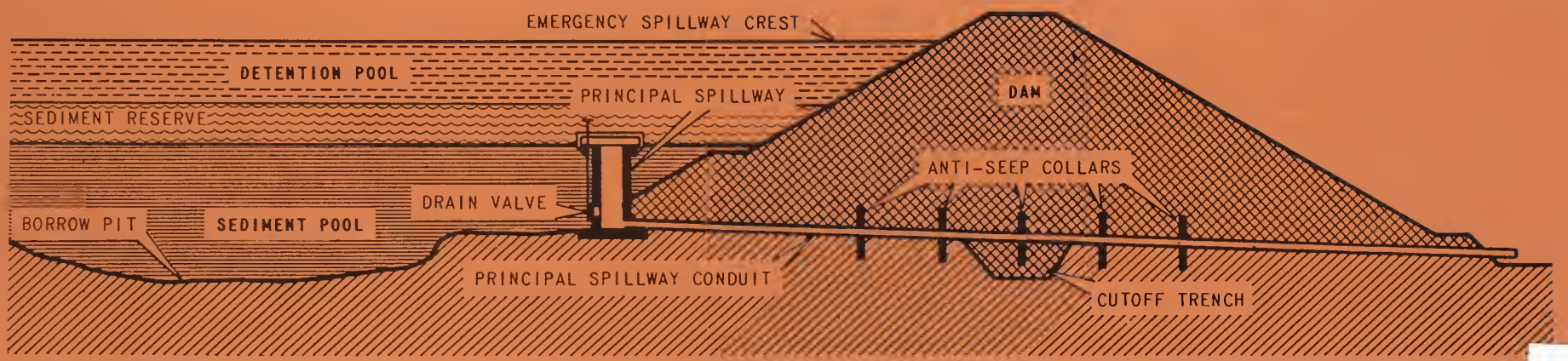


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
USDA-SCS-FORT WORTH, TEX 1965

2-65 4-L-19819